Soil-gas helium and radon data from parts of west-central Ventura County, California

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U.S. DEPARTMENT OF THE INTERIOR
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Introduction

Soil-gas samples were collected and analyzed for helium during a 1981 evaluation of the uranium potential of an area within the Los Padres National Forest in Ventura County, California. The study area in the Transverse Ranges also included other nearby areas to provide additional information for the evaluation and interpretation of data. After an aerial radiometric survey became available, the study area was expanded in 1982 with a sample traverse along upper Sespe Creek. In 1983, a part of the upper Sespe Creek traverse was sampled again for helium; in addition, radon samples were also collected and radioactivity levels were recorded.

Acknowledgements

The able assistance of Josh Been, the late Don Murrey, Harry Day, Kim Green and Pam Rotillie during collection and analysis of samples is gratefully acknowledged. K. A. Dickinson, V. A. Frizzell, Jr., J. F. Morrone, and F. C. Moser made available radiometric and geologic data following the initial helium sampling in 1981. The additional sampling and analysis of soil gases and measurement of radioactivity in 1983 by Murrey and Been contributed significantly to our study.

Data Collection

In 1981, helium surveys were made in five areas: the Laguna and Superior Ridge area, the Ojai and Upper Ojai Valleys and Black Mountain area, part of the upper Sespe Creek area, the lower Sespe Creek area (which includes adjoining sites in the Piru Mountains north of Fillmore), and an oil seepage area (fig.1, areas I-V, respectively). The soil-gas helium data from 279 sites of the 1981 study are presented in Appendix 1.

The sampling procedure and analytical techniques are those described by Reimer (1976). Soil-gas was sampled at a 0.75-meter (m) depth using a hollow steel probe equipped with a needle guide valve containing a rubber septum. The samples for helium analysis were collected in 10-cubic centimeter (cm^3) hypodermic syringes. The analytical equipment used for helium analysis consisted of a small mass spectrometer that was truck-mounted (Reimer, l976), and capable of performing an analysis with a sensitivity of $\pm$ 10 parts per billion (ppb).

The study area was expanded in 1982 to include the sampling for helium at an additional 45 sites along upper Sespe Creek (fig. 1, area III). These data are also presented in Appendix 1.

In 1983, soil-gas helium sampling and analysis were repeated for 24 sites in the eastern and central parts of the 1982 sample traverse along upper Sespe Creek, and radiometric measurements were made. Helium samples were collected and radiometric measurements were made at consecutive sites, and radon samples were taken at alternate sites. These data are presented in Appendix 2.

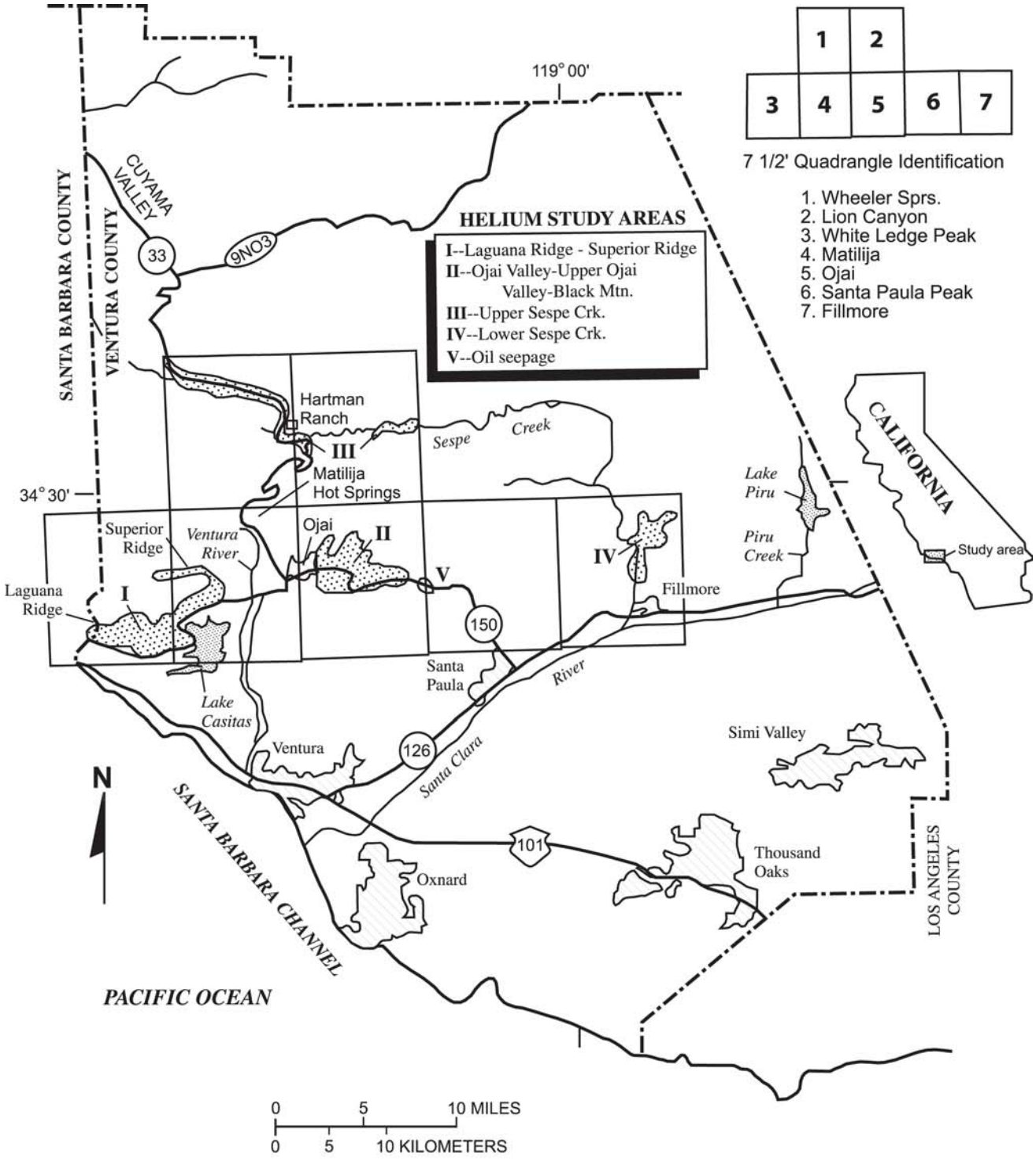


FIGURE 1. Index map showing location of helium study areas (stippled pattern) within Ventura County, California.

Soil-gas radon samples were collected in the same manner as the helium samples, the only difference being that 50 cm^3 of gas were collected instead of l0 cm^3. All samples were analyzed the evening of the sampling date. Radiation from the radon soil-gas samples was counted with a portable activated-phosphor alpha-sensitive scintillometer equipped with a modified inlet system to accept gas injected from a hypodermic syringe.

Surface radiation measurements of the 1983 survey were made with a portable scintillometer at each sample locality. These data are reported in counts per second (cps). The surface radiation data supplement an aerial radiometric survey that was flown during August 1981 by High Life Helicopter, Inc. (Dickinson and others, 1982).

Data Reduction

Helium data were reduced empirically to compensate for the diurnal variation in barometric pressure that affected the concentration of helium. During the first phase of the investigation helium data were reduced by a method (referred to as method 1) that determined diurnal variation from the mean helium concentration of samples collected August 17-19, 1981. A correction for this variation was derived by using a diurnal correction curve, which was constructed from 3-hour moving averages of the soil-gas helium concentration for samples collected during the three-day period (fig. 2). The three-hour moving-average control points were calculated for every half-hour time period. However, to avoid a time lag for the correction curve the averages were plotted in the middle of each three-hour time interval. All calculations were based on the total helium concentration; these data, reported in Appendix 1, were converted to a helium concentration relative to that in ambient air (5,240 ppb He).

A second phase of data reduction (referred to as method 2) followed an evaluation of meteorological data recorded by the National Weather Service at Santa Barbara, California (about 25 miles from the center of study area I). The meteorological data covered a period of time commencing before and continuing throughout the period of sample collection. This modification to method 1 was made to provide a correction that included the effects of the cyclonic/anti-cyclonic barometric pressure cycle.

Data reduction by method 2 was accomplished by first subtracting the mean total-helium value for the 3-day period (5,277 ppb) from the mean total-helium concentration of each of the three days of sample collection. Then the helium correction from each day's diurnal correction curve was included. These diurnal helium corrections were determined by curves drawn from plots of each day's hourly mean helium concentration and interpolations were then made of the divergence of the plotted sample data from these lines that connect the hourly mean helium values. As in method 1, the helium value of ambient air was then subtracted from the reduced helium data, and the helium values relative to ambient air were reported in the appendices.

In 1982 a sampling traverse along upper Sespe Creek extended the study area. The reduced helium data from the 1982 study are presented in Appendix 1. An additional survey in 1983 was made along a segment of the traverse. Supplemental soil-gas radon and surface radiation data made at this time are included in Appendix 2. In 1983, a limited number of soil-gas samples were collected during a short period of time. This necessitated a further modification of the data reduction method, which shall be referred to as method 2a.

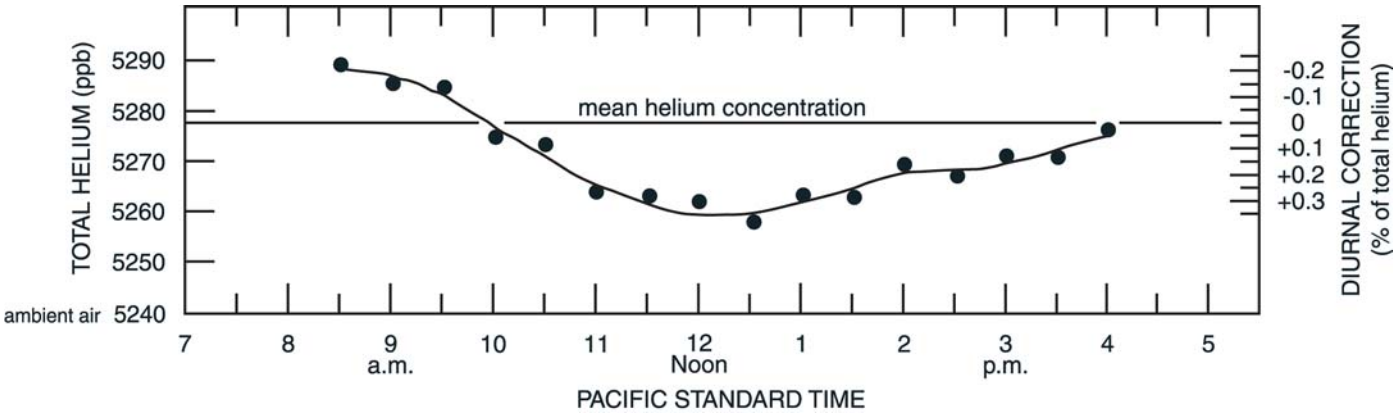


Figure 2 - Curve showing diurnal corrections by method 1 for the total helium concentration in soil-gas samples collected August 17-19, 1981. (Calculated helium averages for successive 3-hour time intervals are plotted at the middle of each interval.)

The method 2a correction required the use of data collected under similar meteorological conditions that occurred during the 1981 survey. The helium data reduced by method 2a is also included in Appendix 2.

The effects of the different methods of data reduction upon the helium concentration of each soil-gas sample are shown in the Appendices tables. Samples having helium concentrations greater than, or less than, one standard deviation from mean value are indicated to assist the evaluation of the soil-gas data. The mean values and standard deviations for uncorrected soil-gas helium data and for data corrected by the different methods of data reduction are presented in text table 1.

Data reduction by method 1 provides a correction for the average diurnal variation of helium concentration during the three-day period of sample collection. This method sought to use the largest possible number of samples for the empirical correction by using the mean value for samples collected over three-hour periods of time (plotted at the mid-point of each time interval) to construct the correction curve. By doing this the possible effects of geologic and hydrologic differences upon the factors used to reduce the data were minimized. However, this correction for the diurnal variation in barometric pressure did not correct for the daily differences in the diurnal pressure curve resulting from the weather cycle (the cyclonic/anti-cyclonic curve).

Data reduction by method 2 did provide this additional correction for the cyclonic/anti-cyclonic pressure cycle by using a correction for the mean daily helium concentration, which was applied to the diurnal curve for each day. Although this method provides a correction for both the diurnal and cyclonic/anti-cyclonic pressure cycles, data from any site is more likely to be affected by geologic and hydrologic factors.

Data reduction by method 2a was necessitated by the limited number of samples collected and by the fact that the shorter time-period for sample collection did not permit a calculation of the mean helium concentration and diurnal curve that could enable a comparison of that day's data with data from the earlier surveys. The correction curve used for method 2a was that calculated for the August 18, 1981 data, because the meteorological conditions most closely approximated the conditions of that day.

The data collected during this study has provided insight into the influence of plate tectonics upon Quaternary uranium epigenesis in Ventura County, California.

References

Dickinson, K. A., and Frizzell, V. A., Jr., Bowles, C. G., and Morrone, J. F. (1984), Airborne radiometric survey, geochemical data, and uranium occurrences in west-central Ventura County, California: U.S. Geological Survey, Open-File Report, 82-818C.

Reimer, G. M., (1976), Design and assembly of a portable helium detector for evaluation as a uranium exploration instrument: U.S. Geological Survey Open-File Report 76-398, 18 p.

Table 1- Comparison of uncorrected and corrected soil-gas helium values for samples collected in Ventura County, California. N indicates the number of samples. M indicates the mean helium value for soil-gas samples collected each day. S indicates the standard deviation from the mean value for soil-gas samples in this group. All data are rounded and reported in parts per billion relative to ambient air (5,240 ppb He). Standard deviation data reported in Appendix 1 and 2 are based upon this table.

August 1981									
	Day			Day			Day		
	17th	18th	19th	17th	18th	19th	17th	18th	19th
	Uncorrected helium			Corrected helium method 1			Corrected helium method 2		
N	90	113	74*	90	113	74*	90	113	74*
M	33	37	42	36	36	37	36	37	34
S	25	26	27	25	25	26	25	25	25
+3 S	109	115	123	110	110	114	110	112	110
+2 S	84	89	96	86	85	88	86	87	85
+1 S	59	63	69	61	61	63	61	62	59
M	**33**	**37**	**42**	**36**	**36**	**37**	**36**	**37**	**34**
-1 S	8	11	15	12	12	11	12	12	9
-2 S	-17	-15	-12	-13	-13	-14	-12	-13	-16
-3 S	-42	-41	-39	-38	-37	-40	-36	-38	-41
Samples from the oil seepage area are included									
N			78			78			78
M			39			35			33
S			30			27			27
+3 S			130			118			114
+2 S			100			90			87
+1 S			69			63			60
M			**39**			**35**			**33**
-1 S			9			8			6
-2 S			-21			-20			-21
-3 S			-51			-47			-49

*Four samples from the oil seepage area are not included in the calculations

Table 1 continued

August 1982 and April 1983								
	1982		1983	Average 1982 & 1983		1982	1983	Average 1982 & 1983
	Uncorrected helium					Corrected helium method 2a		
N	45	23**	23**	23**		45	23**	23**	23**
M	81	79	40	59		77	69	50	59
S	30	34	21	21		29	35	26	22
+3 S	172	181	101	123		165	175	129	125
+2 S	142	147	81	102		136	139	102	103
+1 S	111	113	60	81		107	104	76	81
M	**81**	**79**	**40**	**59**		**77**	**69**	**50**	**59**
-1 S	51	45	19	38		48	34	23	38
-2 S	20	11	-2	17		18	-1	-3	16
-3 S	-10	-23	-22	-4		-11	-36	-29	-6

**Samples used for m and s calculations were collected at localitites #2-24 reported in the Appendices. The omission of data from locality #1 from the calculations was an arbitrary decision resulting from an extremely anomalous helium concentration at this locality on April 5, 1983

Appendix 1. Helium data from soil-gas samples collected in 1981 and 1982 in Ventura County, California. [Helium values are relative to ambient air (5,240 ppb He). Number within parentheses, or appearing above the horizontal line, indicates the whole-number of the standard deviation from the mean calculated from samples collected on that date. The number appearing below the line in bold type indicates the whole number of the standard deviation referenced to samples collected on 8/18/81. [See text table 1 for mean and standard deviation values for these dates.]

LAGUNA RIDGE-SUPERIOR RIDGE AREA

White Ledge Peak 7.5-minute Quadrangle

Sample No.	Date	Time (LST)	Helium (ppb) [uncorrected]	Helium (ppb) [corrected by method 1]	Helium (ppb) [corrected by method 2]
1	8/18/81	8:08	43	30	30
2	8/18/81	8:12	64 **(+1)**	51	52
3	8/18/81	8:17	64 **(+1)**	51	52
4	8/18/81	8:32	21	8 **(-1)**	10 **(-1)**
5	8/18/81	8:42	21	8 **(-1)**	11 **(-1)**
6	8/18/81	8:45	43	31	33
7	8/18/81	8:47	43	31	33
8	8/18/81	8:53	43	31	34
9	8/18/81	8:58	43	31	34
10	8/18/81	9:03	65 **(+1)**	53	56
11	8/18/81	9:05	43	32	34
12	8/18/81	9:11	22	12	14
13	8/18/81	9:16	65 **(+1)**	55	57
14	8/18/81	9:20	43	34	33
15	8/18/81	9:25	43	34	34
16	8/18/81	9:30	22	14	15
17	8/18/81	9:36	65 **(+1)**	58	60 **(+1)**
18	8/18/81	9:42	43	37	38
19	8/19/81	7:15	71 **(+1)**	58	60
20	8/19/81	7:20	42	29	32
21	8/19/81	7:24	50	37	40
22	8/19/81	7:48	50	37	39

Appendix 1 (continued)

23	8/19/81	7:54		55		42		44	
24	8/18/81	8:30	est.	56		43		45	
25	8/18/81	8:45	est.	56		43		46	
26	8/18/81	9:00	est.	56		43		46	
27	8/18/81	9:15	est.	37		25		29	
28	8/18/81	9:30	est.	111	**(+2)**	99	**(+2)**	104	**(+2)**
29	8/18/81	9:45	est.	93	**(+2)**	81	**(+1)**	89	**(+2)**
30	8/18/81	8:30	est.	85	**(+1)**	80	**(+1)**	74	**(+1)**
31	8/18/81	8:43	est.	56		48		46	
32	8/18/81	8:56	est.	56		52		47	
33	8/18/81	9:09	est.	56		52		47	
34	8/18/81	9:22	est.	19		17		11	**(-1)**
35	8/18/81	9:35	est.	11		12		5	**(-1)**
36	8/18/81	9:48	est.	56		63	**(+1)**	53	
37	8/18/81	10:00	est.	19		28		18	
38	8/18/81	11:05		19		29		29	
39*	8/18/81	11:05		130		NA		NA	
40	8/18/81	11:10		19		29		29	
41	8/18/81	11:15		19		30		30	
42	8/18/81	11:20		37		49		48	
43	8/17/81	13:50		43		52		51	
44	8/17/81	13:59		44		52		54	
45	8/17/81	14:00		65	**(+1)**	73	**(+1)**	75	**(+1)**
46	8/17/81	14:05		22		30		31	
47	8/17/81	14:11		21		29		28	
48	8/17/81	14:10		43		51		50	
49	8/17/81	14:18		21		28		27	
50	8/17/81	14:15		22		29		28	
51	8/17/81	14:20		73	**(+1)**	80	**(+1)**	79	**(+1)**
52	8/17/81	14:27		65	**(+1)**	72	**(+1)**	69	**(+1)**
53	8/18/81	9:13		19		9	**(-1)**	10	**(-1)**
54	8/18/81	9:05		19		8	**(-1)**	10	**(-1)**

*spring water

Appendix 1 (continued)

55	8/18/81	9:29	19		11	**(-1)**	12	**(-1)**
56	8/18/81	9:55	38		35		36	
57	8/18/81	10:27	0	**(-1)**	3	**(-1)**	5	**(-1)**
58	8/18/81	10:09	19		19		20	
59	8/18/81	10:34	57		62	**(+1)**	63	**(+1)**
60	8/18/81	10:46	38		45		45	
61	8/18/81	10:57	0	**(-1)**	8	**(-1)**	8	**(-1)**
62	8/18/81	11:16	38		49		49	
63	8/18/81	11:26	19		32		31	
64	8/18/81	12:00	38		55		58	
65	8/18/81	12:07	19		35		40	
66	8/18/81	12:17	0	**(-1)**	16		23	
67	8/18/81	12:25	-19	**(-2)**	-4	**(-1)**	6	**(-1)**
68	8/18/81	15:06	40		45		49	
69	8/18/81	15:17	40		44		53	
70	8/18/81	15:29	0	**(-1)**	3	**(-1)**	17	**(-1)**
71	8/18/81	12:45	20		36		40	
72	8/18/81	13:00	60		74	**(+1)**	75	**(+1)**
73	8/18/81	13:07	40		53		52	
74	8/18/81	13:10	40		53		51	
75	8/18/81	14:15	40		52		50	

Appendix 1 (continued)

LAGUNA RIDGE-SUPERIOR RIDGE AREA

Matilija 7.5-minute Quadrangle

Sample No.	Date	Time (LST)	Helium (ppb) [uncorrected]	Helium (ppb) [corrected by method 1]	Helium (ppb) [corrected by method 2]
76	8/18/81	9:45	43	38	39
77	8/18/81	9:52	56	52	54
78	8/18/81	10:05	43	42	43
79	8/17/81	13:30	22	32	39
80	8/17/81	13:42	21	30	35
81	8/17/81	13:45	-22 **(-2)**	-13 **(-2)**	-9 **(-1)**
82	8/17/81	13:50	8 **(-1)**	17	20
83	8/17/81	15:00	65 **(+1)**	71 **(+1)**	70 **(+1)**
84	8/17/81	15:05	43	49	49
85	8/17/81	15:10	43	48	49
86	8/17/81	15:15	30	34	37
87	8/17/81	15:30	0 **(-1)**	3 **(-1)**	7 **(-1)**
88	8/17/81	15:35	0 **(-1)**	3 **(-1)**	7 **(-1)**
89	8/17/81	15:40	0 **(-1)**	2 **(-1)**	7 **(-1)**
90	8/17/81	16:10	1 **(-1)**	5 **(-1)**	5 **(-1)**
91	8/18/81	8:00	19	6 **(-1)**	6 **(-1)**
92	8/18/81	8:12	11	2 **(-1)**	-1 **(-1)**
93	8/18/81	8:17	26	13	14
94	8/18/81	8:25	56	43	45
95	8/18/81	8:30	26	13	15
96	8/18/81	8:41	19	6 **(-1)**	9 **(-1)**
97	8/18/81	9:00	-26 **(-2)**	-38 **(-3)**	-35 **(-2)**
98	8/18/81	9:10	111 **(+2)**	100 **(+2)**	103 **(+2)**
100	8/18/81	10:07	74 **(+1)**	73 **(+1)**	75 **(+1)**

Appendix 1 (continued)

101	8/18/81	10:25	37		40		41	
102	8/18/81	10:35	37		42		43	
103	8/18/81	13:18	60		72	**(+1)**	68	**(+1)**
104	8/18/81	13:20	80	**(+1)**	92	**(+2)**	88	**(+2)**
105	8/18/81	13:22	40		51		47	
106	8/18/81	13:23	20		31		26	
107	8/18/81	13:25	40		51		46	
108	8/18/81	13:32	20		30		24	
109	8/18/81	13:36	20		30		23	
110	8/18/81	13:40	40		50		43	
111	8/18/81	13:45	40		49		42	
112	8/18/81	14:00	40		48		40	
113	8/18/81	14:20	60		67	**(+1)**	58	
114	8/18/81	14:35	80	**(+1)**	87	**(+2)**	78	**(+1)**
115	8/18/81	14:42	20		27		21	
116	8/18/81	14:46	20		26		22	
117	8/18/81	14:50	20		26		23	
118	8/18/81	15:00	20		26		27	
119	8/18/81	15:05	0	**(-1)**	5	**(-1)**	9	**(-1)**
120	8/17/81	15:07	44		49		50	
121	8/17/81	15:28	-21	**(-2)**	-18	**(-2)**	-14	**(-2)**
122	8/17/81	15:52	0	**(-1)**	2	**(-1)**	6	**(-1)**
123	8/17/81	16:01	31		32		37	
124	8/17/81	16:11	44		45		49	
125	8/17/81	16:17	31		32		35	
126	8/17/81	16:30	44		45		48	
127	8/17/81	16:46	21		22		23	
128	8/17/81	16:51	44		45		46	
129	8/17/81	13:37	-21	**(-2)**	-11	**(-1)**	-6	**(-1)**
1071	8/17/81	14:03	0	**(-1)**	8	**(-1)**	9	**(-1)**
1072	8/17/81	14:29	120	**(+3)**	131	**(+3)**	124	**(+3)**
1073	8/17/81	14:51	40		52		45	

Appendix 1 (continued)

OJAI VALLEY-UPPER OJAI VALLEY-BLACK MOUNTAIN AREA

Ojai 7.5-minute Quadrangle

Sample No.	Date	Time (LST)	Helium (ppb) [uncorrected]	Helium (ppb) [corrected by method 1]	Helium (ppb) [corrected by method 2]
130	8/19/81	14:09	0	8	5 **(-1)**
131	8/19/81	14:27	7 **(-1)**	14	-2 **(-1)**
132	8/19/81	14:35	-11 **(-1)**	-4 **(-1)**	-21 **(-2)**
133	8/19/81	15:11	19	24	9 **(-1)**
134	8/19/81	15:39	37	39	27
135	8/19/81	16:18	74 **(+1)**	75 **(+1)**	64 **(+1)**
136	8/17/81	8:26	63 **(+1)**	50	51
137	8/17/81	8:31	63 **(+1)**	50	51
138	8/17/81	8:40	21	8 **(-1)**	10 **(-1)**
139	8/17/81	8:45	34	22	24
140	8/17/81	8:50	34	22	24
141	8/17/81	8:56	71 **(+1)**	59	62 **(+1)**
142	8/17/81	9:04	92 **(+2)**	80 **(+1)**	84 **(+1)**
143	8/17/81	9:08	34	23	26
144	8/17/81	9:13	72 **(+1)**	62 **(+1)**	65 **(+1)**
145	8/17/81	9:18	63 **(+1)**	53	57
146	8/17/81	9:22	55	46	49
147	8/17/81	9:29	0 **(-1)**	-8 **(-1)**	-5 **(-1)**
148	8/17/81	9:35	63 **(+1)**	56	58
149	8/17/81	9:40	-21 **(-2)**	-27 **(-2)**	-26 **(-2)**
150	8/17/81	9:45	21	16	16
151	8/17/81	9:50	42	38	37
152	8/17/81	9:56	29	26	24
153	8/17/81	10:02	42	40	37

Appendix 1 (continued

154	8/17/81	10:07	42		41		37	
155	8/17/81	10:14	21		22		16	
156	8/17/81	10:23	0	**(-1)**	3	**(-1)**	-4	**(-1)**
157	8/17/81	10:32	55		59		51	
158	8/17/81	10:39	63	**(+1)**	69	**(+1)**	59	
159	8/17/81	10:45	63	**(+1)**	70	**(+1)**	60	
160	8/17/81	10:51	31		39		28	
161	8/17/81	10:55	44		52		42	
162	8/17/81	11:00	66	**(+1)**	75	**(+1)**	64	**(+1)**
163	8/17/81	11:05	22		32		20	
164	8/17/81	11:11	22		33		21	
165	8/17/81	11:17	44		56		43	
166	8/17/81	11:22	22		34		22	
167	8/17/81	13:35	13		23		28	
168	8/17/81	13:40	13		23		27	
169	8/17/81	13:45	44		53		57	
170	8/17/81	13:52	44		53		55	
171	8/17/81	13:57	22		30		32	
172	8/17/81	14:04	0	**(-1)**	8	**(-1)**	9	**(-1)**
173	8/17/81	14:10	44		52		52	
174	8/17/81	14:20	13		20		19	
175	8/17/81	14:24	44		51		49	
176	8/17/81	14:30	0	**(-1)**	7	**(-1)**	3	**(-1)**
177	8/17/81	14:37	13		20		17	
178	8/17/81	14:55	44		50		49	
179	8/17/81	15:02	42		48		48	
180	8/17/81	15:11	42		47		48	
181	8/17/81	15:16	42		46		48	
182	8/17/81	15:21	55		59		62	**(+1)**
183	8/17/81	15:25	21		24		28	
184	8/17/81	15:31	42		45		50	
185	8/17/81	15:36	21		24		28	
186	8/17/81	15:40	29		31		36	

Appendix 1 (continued)

187	8/17/81	15:45	21		23		28	
188	8/17/81	15:51	21		23		27	
189	8/17/81	15:56	55		56		61	
190	8/17/81	16:02	42		43		48	
191	8/18/81	7:31	22		9	**(-1)**	6	**(-1)**
192	8/18/81	7:38	86	**(+1)**	73	**(+1)**	71	**(+1)**
193	8/18/81	8:05	86	**(+1)**	73	**(+1)**	73	**(+1)**
194	8/18/81	8:15	43		30		31	
195	8/18/81	8:21	65	**(+1)**	52		53	
196	8/18/81	8:28	73	**(+1)**	60		62	**(+1)**
197	8/18/81	8:34	86	**(+1)**	73	**(+1)**	75	**(+1)**
198	8/18/81	8:40	65	**(+1)**	52		55	
199	8/18/81	9:15	43		33		35	
200	8/19/81	7:05	18		5	**(-1)**	8	**(-1)**
201	8/19/81	7:17	11	**(-1)**	-2	**(-1)**	1	**(-1)**
202	8/19/81	7:29	13	**(-1)**	0	**(-1)**	2	**(-1)**
203	8/19/81	7:38	84	**(+1)**	71	**(+1)**	73	**(+1)**
204	8/19/81	7:50	63		50		52	
205	8/19/81	8:04	71	**(+1)**	58		60	**(+1)**
206	8/19/81	8:16	84	**(+1)**	71	**(+1)**	73	**(+1)**

Appendix 1 (continued)

LOWER SESPE CREEK AREA

Fillmore 7.5-minute Quadrangle

Sample No.	Date	Time (LST)	Helium (ppb) [uncorrected]	Helium (ppb) [corrected by method 1]	Helium (ppb) [corrected by method 2]
207	8/19/81	7:40	41	28	30
208	8/19/81	7:45	41	28	30
209	8/19/81	7:50	70 **(+1)**	57	59 **(+1)**
210	8/19/81	7:55	61	48	51
211	8/19/81	8:00	41	28	30
212	8/19/81	8:05	53	40	42
213	8/19/81	8:10	82 **(+1)**	69 **(+1)**	71 **(+1)**
214	8/19/81	8:20	0 **(-1)**	-13 **(-1)**	-11 **(-1)**
215	8/19/81	9:50	20	16	16
216	8/19/81	9:55	103 **(+2)**	100 **(+2)**	100 **(+2)**
217	8/19/81	10:00	49	47	47
218	8/19/81	7:45	27	14	16
219	8/19/81	7:50	59	46	48
220	8/19/81	8:00	66	53	55
221	8/19/81	8:05	59	46	48
222	8/19/81	8:10	39	26	28
223	8/19/81		78 **(+1)**	65 **(+1)**	67 **(+1)**
224	8/19/81	8:15	20	7 **(-1)**	9
225	8/19/81	8:40	20	7 **(-1)**	9
226	8/19/81	8:45	31	19	21
227	8/19/81	8:50	0 **(-1)**	-12 **(-1)**	-10 **(-1)**
228	8/19/81		78 **(+1)**	66	68
229	8/19/81	9:00	39	27	29
230	8/19/81		59	48	50

Appendix 1 (continued)

231	8/19/81	9:05	39		28		30	
232	8/19/81	9:40	47		41		42	
233	8/19/81	9:50	39		35		35	
234	8/19/81		59		48		49	
235	8/19/81		39		27		29	
236	8/19/81	9:25	19		10		11	
237	8/19/81	9:38	49		43		43	
238	8/19/81	9:44	57		52		52	
239	8/19/81	9:49	49		45		45	
240	8/19/81	9:55	0	**(-1)**	-3	**(-1)**	-3	**(-1)**
241	8/19/81	10:01	65		63	**(+1)**	63	**(+1)**
242	8/19/81	10:06	38		37		37	
243	8/19/81	10:24	38		40		41	
244	8/19/81	10:40	0	**(-1)**	6	**(-1)**	6	**(-1)**
245	8/19/81	10:48	19		26		26	
246	8/19/81	10:55	19		27		27	
247	8/19/81	11:07	-38	**(-2)**	-28	**(-1)**	-28	**(-2)**
248	8/19/81	11:14	0	**(-1)**	11		11	

Appendix 1 (continued)

UPPER SESPE CREEK AREA

Lion Canyon 7.5-minute Quadrangle

Sample No.	Date	Time (LST)	Helium (ppb) [uncorrected]	Helium (ppb) [corrected by method 1]	Helium (ppb) [corrected by method 2]
249	8/19/81	14:50	37	43	27
250	8/19/81	14:45	74 **(+1)**	81 **(+1)**	64 **(+1)**
251	8/19/81	14:37	56	63 **(+1)**	46
252	8/19/81	14:30	11 **(-1)**	18	1 **(-1)**
253	8/19/81	14:25	63	70 **(+1)**	54
254	8/19/81	14:10	74 **(+1)**	82 **(+1)**	68 **(+1)**
255	8/18/81	13:20	19	30	27
256	8/18/81	13:25	19	30	25
257	8/18/81	13:28	19	30	23
258	8/18/81	13:35	0 **(-1)**	10 **(-1)**	3 **(-1)**
259	8/18/81	13:40	19	28	22
260	8/18/81	14:45	19	28	21
261	8/18/81	14:50	38	47	41
262	8/18/81		40		
263	8/18/81	16:05	-37 **(-2)**	-36 **(-2)**	-22 **(-2)**
264	8/18/81		20		
265	8/19/81	16:00	19	20	9 **(-1)**
266	8/18/81		0 **(-1)**		
267	8/19/81	15:57	37	38	27
268	8/18/81		0 **(-1)**		
269	8/19/81	15:53	93 **(+1)**	94 **(+2)**	83 **(+1)**
270	8/18/81		20		
271	8/19/81	15:41	37	39	27

272	8/19/81	15:50	56	58	46
273	8/19/81	15:35	56	59	46
274	8/19/81	15:16	37	41	27
275	8/19/81	14:56	37	43	27

UPPER SESPE CREEK AREA (continued)
Wheeler Springs 7.5-minute Quadrangle

Sample No.	Locality No.	Date	Time (LST)	Helium (ppb) [uncorrected]	Helium (ppb) [corrected by method 2a]
276	24	8/12/82	7:50	27 $^{-1}$	13 $^{-2}$
277	23	8/12/82	8:00	72 $\overline{+1}$	59
278	22	8/12/82	8:05	0 $^{-2}_{-1}$	-13 $^{-3}_{-2}$
279	1	8/12/82	8:10	108 $\overline{+2}$	94 $\overline{+2}$
280	2	8/12/82	8:15	90 $\overline{+1}$	78 $\overline{+1}$
281	3	8/12/82	8:20	72 $\overline{+1}$	60
282	4	8/12/82	8:25	54	43 $^{-1}$
283	5	8/12/82	8:28	72 $\overline{+1}$	61
284	6	8/12/82	8:32	126 $^{+2}_{+3}$	115 $^{+1}_{+3}$
285	7	8/12/82	8:35	90 $\overline{+1}$	80 $\overline{+1}$
286	8	8/12/82	8:40	90 $\overline{+1}$	80 $\overline{+1}$
287	9	8/12/82	8:45	36 $^{-1}$	26 $^{-1}$
288	10	8/12/82	8:50	72 $\overline{+1}$	62 $\overline{+1}$
289	11	8/12/82	8:55	36 $^{-1}$	27 $^{-1}$
290	12	8/12/82	9:00	72 $\overline{+1}$	63 $\overline{+1}$
291	13	8/12/82	9:02	108 $\overline{+2}$	99 $\overline{+2}$
292	14	8/12/82	9:05	108 $\overline{+2}$	99 $\overline{+2}$
293	15	8/12/82	9:10	108 $\overline{+2}$	100 $\overline{+2}$

Appendix 1 (continued)

294	16	8/12/82	9:13	90 $\overline{+1}$	82 $\overline{+1}$
295	17	8/12/82	9:15	108 $\overline{+2}$	99 $\overline{+2}$
296	18	8/12/82	9:20	82 $\overline{+1}$	74 $\overline{+1}$
297	19	8/12/82	9:25	72 $\overline{+1}$	64 $\overline{+1}$
298	20	8/12/82	9:30	72 $\overline{+1}$	65 $\overline{+1}$
299	21	8/12/82	9:35	162 $\frac{+2}{+4}$	156 $\frac{+2}{+4}$

UPPER SESPE CREEK AREA (continued)
Wheeler Springs 7.5-minute Quadrangle

Sample No.	Date	Time (LST)	Helium (ppb) [uncorrected]	Helium (ppb) [corrected by method 2a]
300	8/12/82	9:40	47 $\overline{-1}$	42 $\overline{-1}$
301	8/12/82	9:45	96 $\overline{+2}$	92 $\overline{+1}$
302	8/12/82	9:50	81 $\overline{+1}$	78 $\overline{+1}$
303	8/12/82	9:55	128 $\frac{+1}{+3}$	126 $\frac{+1}{+3}$
304	8/12/82	10:05	70 $\overline{+1}$	71 $\overline{+1}$
305	8/12/82	10:10	64	65 $\overline{+1}$
306	8/12/82	10:12	64	66 $\overline{+1}$
307	8/12/82	10:15	128 $\frac{+1}{+3}$	130 $\frac{+1}{+3}$
308	8/12/82	10:18	96 $\overline{+2}$	99 $\overline{+2}$
309	8/12/82	10:20	64	67 $\overline{+1}$
310	8/12/82	10:22	48 $\overline{-1}$	52
311	8/12/82	10:25	64	68 $\overline{+1}$
312	8/12/82	10:30	96 $\overline{+2}$	101 $\overline{+2}$
313	8/12/82	10:32	112 $\frac{+1}{+2}$	118 $\frac{+1}{+3}$

Appendix 1 (continued)

314	8/12/82	10:35	96 +2	102 +2
315	8/12/82	10:40	96 +2	103 +2
316	8/12/82	10:42	70 +1	77 +1
317	8/12/82	10:45	96 +2	103 +2
318	8/12/82	10:50	70 +1	77 +1
319	8/12/82	10:53	32 -1	40 -1
320	8/12/82	10:55	96 +2	105 +2

Oil Seepage Area
Santa Paula Peak 7.5-minute Quadrangle

Sample No.	Date	Time (LST)	Helium (ppb) [uncorrected]	Helium (ppb) [corrected by method 1]	Helium (ppb) [corrected by method 2]
345	8/19/81	12:43	-49 **(-3)**	-34 **(-2)**	-30 **(-2)**
346	8/19/81	12:52	-49 **(-3)**	-35 **(-2)**	-33 **(-2)**
347	8/19/81	13:10	38	51	60 **(+1)**
348	8/19/81	13:18	19	31	37

Appendix 2. Soil-gas helium and radon data and surface radioactivity recorded April 5, 1983 along upper Sespe Creek in the Wheeler Springs 7.5-minute Quadrangle, Ventura County, California. (Locality numbers correspond to localities listed in Appendices Table 1. Helium values are relative to ambient air (5,240 ppb). Number appearing above the horizontal line indicates the whole number of standard deviations from the mean as calculated from samples collected that day. The number appearing below the line in bold type indicates the whole number of standard deviations referenced to samples collected on 8/18/81. See text table 1 for mean and standard deviation values for these dates.)

Sample No.	Locality No.	Time (LST)	Helium (ppb) [uncorrected]	Helium (ppb) [corrected by method 2a]	Helium Average[1] (ppb) [corrected by method 2a]	Radon (cpm)	Radioactivity (cps)
321	1	12:05	210 $\frac{+8}{\mathbf{+7}}$	231 $\frac{+7}{\mathbf{+7}}$	163 $\frac{+4}{\mathbf{+5}}$	122	3.5
322	2	12:20	84 $\frac{+2}{\mathbf{+2}}$	108 $\frac{+2}{\mathbf{+2}}$	93 $\frac{+1}{\mathbf{+2}}$		3.7
323	3	12:25	70 $\frac{+1}{\mathbf{+1}}$	95 $\frac{+1}{\mathbf{+2}}$	78 $\frac{\ }{\mathbf{+1}}$	72.5	3.5
324	4	12:30	11 $\frac{-1}{\ }$	37	40		3.5
325	5	12:36	40	64 $\frac{\ }{\mathbf{+1}}$	63 $\frac{\ }{\mathbf{+1}}$	<1	4.0
326	6	12:45	42	62 $\frac{\ }{\mathbf{+1}}$	89 $\frac{+1}{\mathbf{+2}}$		3.2
327	7	13:00	60	75 $\frac{+1}{\mathbf{+1}}$	78 $\frac{\ }{\mathbf{+1}}$	8	3.8
328	8	13:05	32	45	63 $\frac{\ }{\mathbf{+1}}$		3.6
329	9	13:09	80 $\frac{\ }{\mathbf{+1}}$	91 $\frac{+1}{\mathbf{+2}}$	59	29.5	3.8
330	10	13:15	40	49	56		4.1
331	11	13:21	20	27	27 $\frac{-1}{\ }$	<1	4.5
332	12	13:26	21	26	45		4.3
333	13	13:33	42	46	73 $\frac{\ }{\mathbf{+1}}$	<1	4.2
334	14	13:42	20	22 $\frac{-1}{\ }$	61		4.0
335	15	13:55	0 $\frac{-1}{\mathbf{-1}}$	1 $\frac{-1}{\mathbf{-1}}$	51	4	4.3
336	16	14:00	42	42	62 $\frac{\ }{\mathbf{+1}}$		3.9
337	17	14:25	42	39	69 $\frac{\ }{\mathbf{+1}}$	32.5	5.0
338	18	14:35	20	18 $\frac{-1}{\ }$	46		3.5
339	19	14:45	32	34	49	27	4.5
340	20	14:50	63 $\frac{\ }{\mathbf{+1}}$	66 $\frac{\ }{\mathbf{+1}}$	66 $\frac{\ }{\mathbf{+1}}$		3.4
341	21	15:00	63 $\frac{\ }{\mathbf{+1}}$	70 $\frac{\ }{\mathbf{+1}}$	113 $\frac{+2}{\mathbf{+3}}$	3.5	3.6

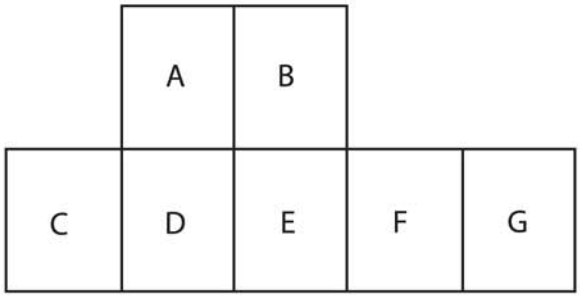
[1]The helium average for each locality was calculated from the 8/12/82 and 4/5/83 soil-gas data.

Table 2 (continued)

342	22	15:15	42	54	21^{-1}		3.5
343	23	15:20	32	46	53	36	3.6
344	24	15:25	11	27	20^{-1}		3.7

Plate 1. Map showing aerial radiometric data and the concentration of helium at soil-gas sample sites in west and central parts of Ventura County, California.

7.5' Quadrangle Location



Quadrangle Identification

A. Wheeler Springs
B. Lion Canyon
C. White Ledge peak
D. Matilija
E. Ojai
F. Santa Paula Peak
G. Fillmore

Explanation

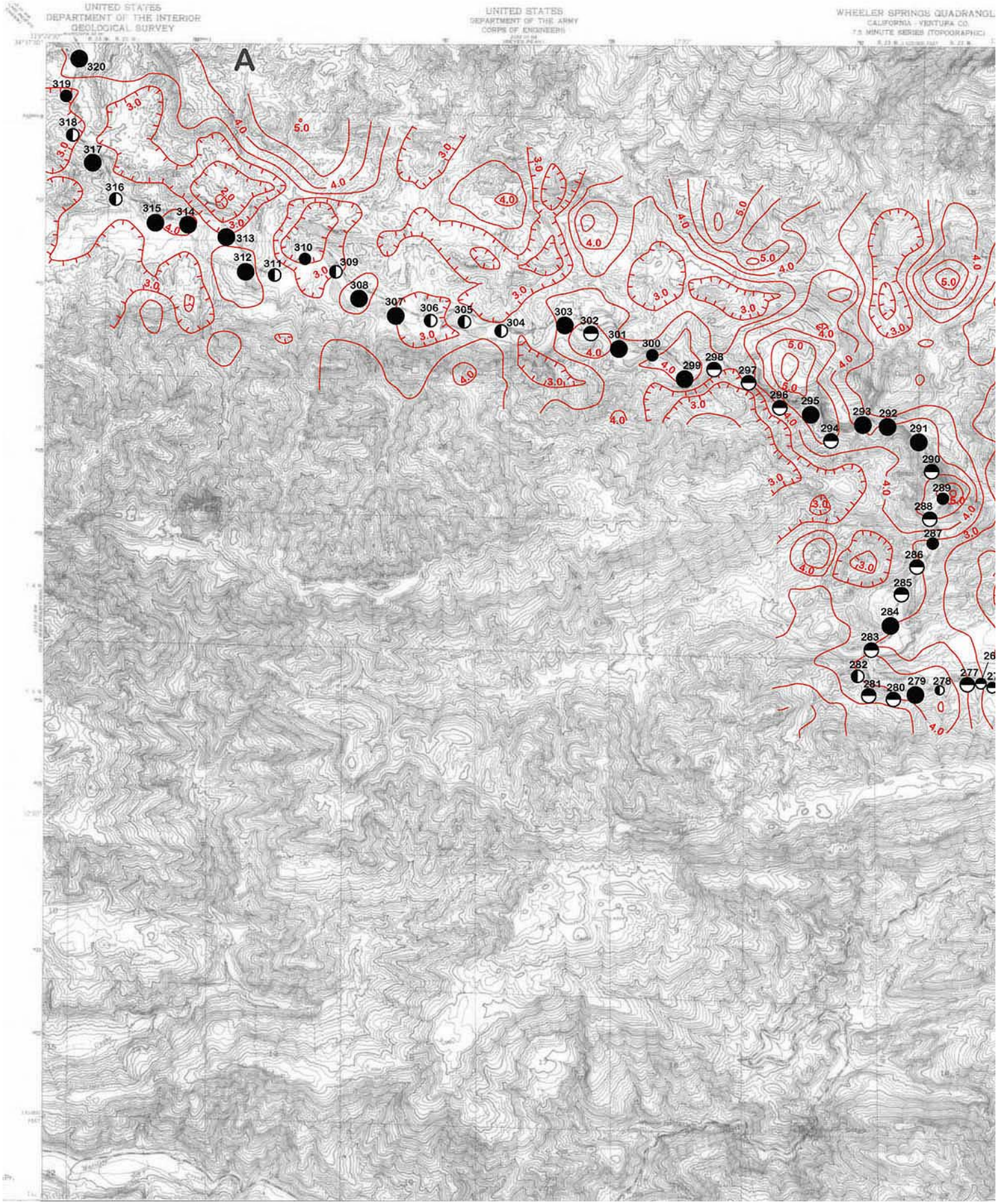
Soil-gas helium (ppb
with respect to ambient air)
Values are uncorrected.
(Symbols indicate data groups within which each sample falls.
For analytical value of each sample check Appendices.)

- ● > 90
- ◓ 71 to 90
- ◐ 51 to 70
- ● 31 to 50
- ◓ 11 to 30
- ◐ -9 to 10
- ▲ < -9

Radioactivity

~ 4.0 ~

(Contour interval
0.5 ppm eU_3O_8)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DEPARTMENT OF THE ARMY
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CALIFORNIA - VENTURA CO.
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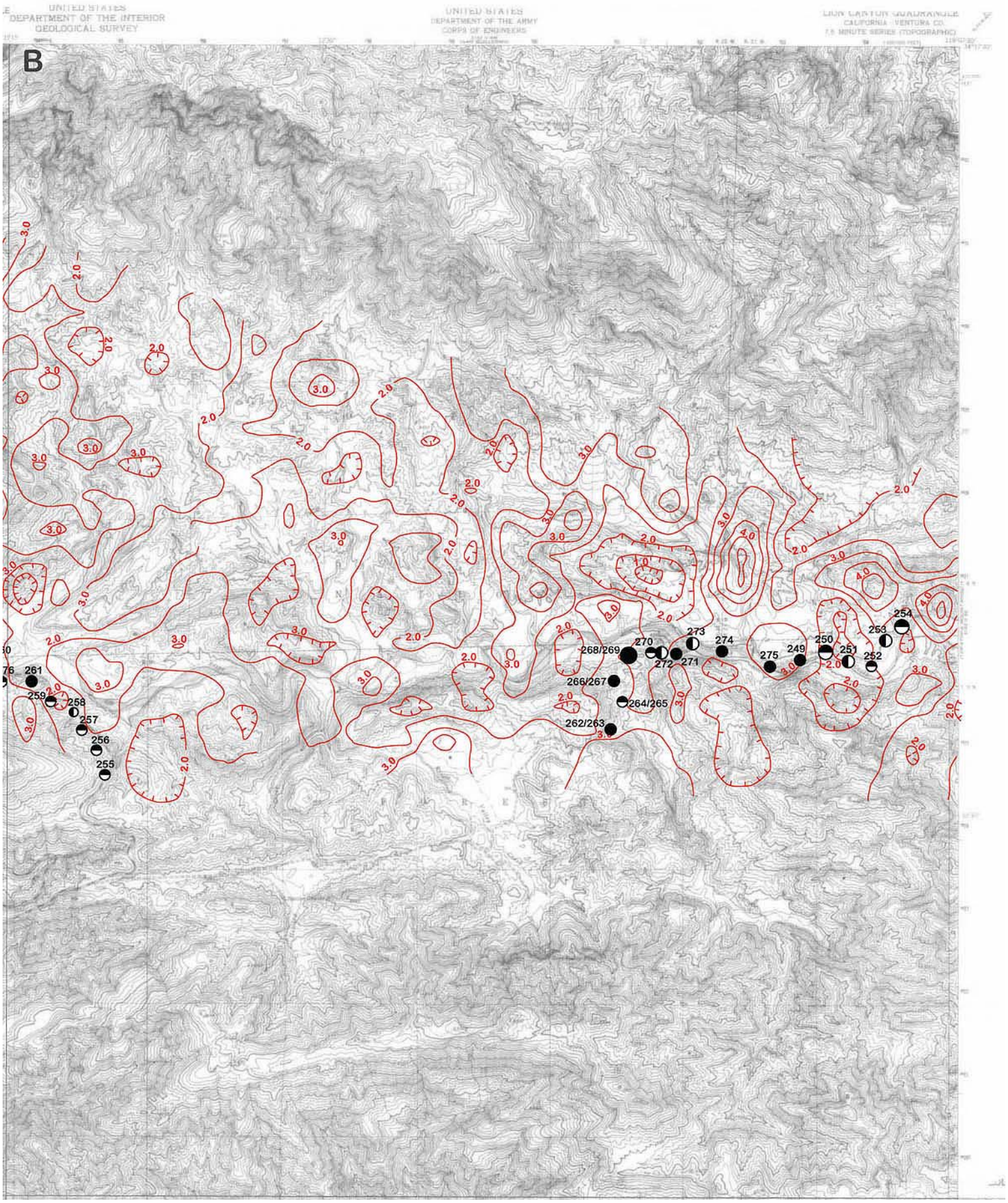
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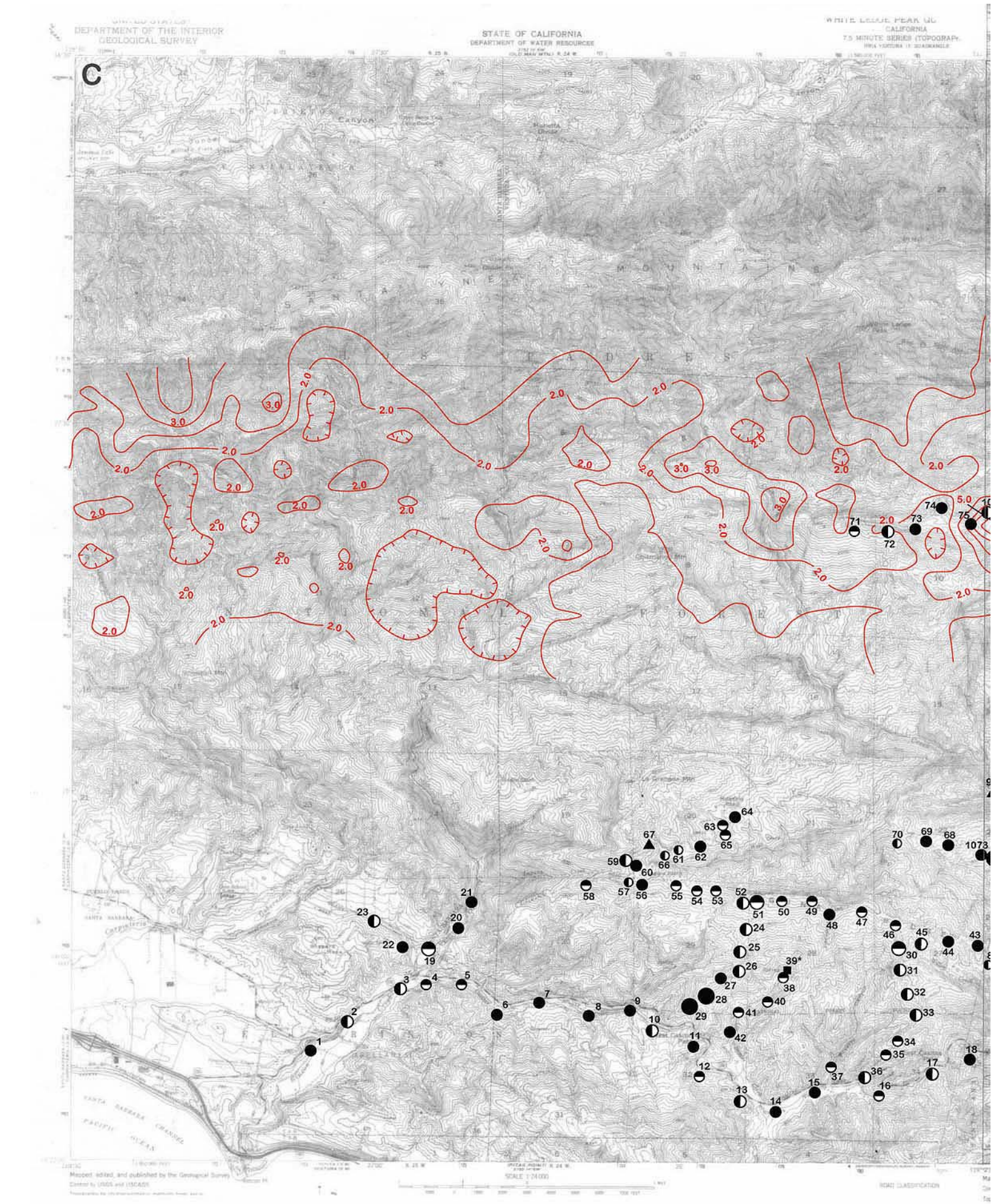
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DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
WHITE LEDGE PEAK QC
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7.5 MINUTE SERIES (TOPOGRAPHIC)
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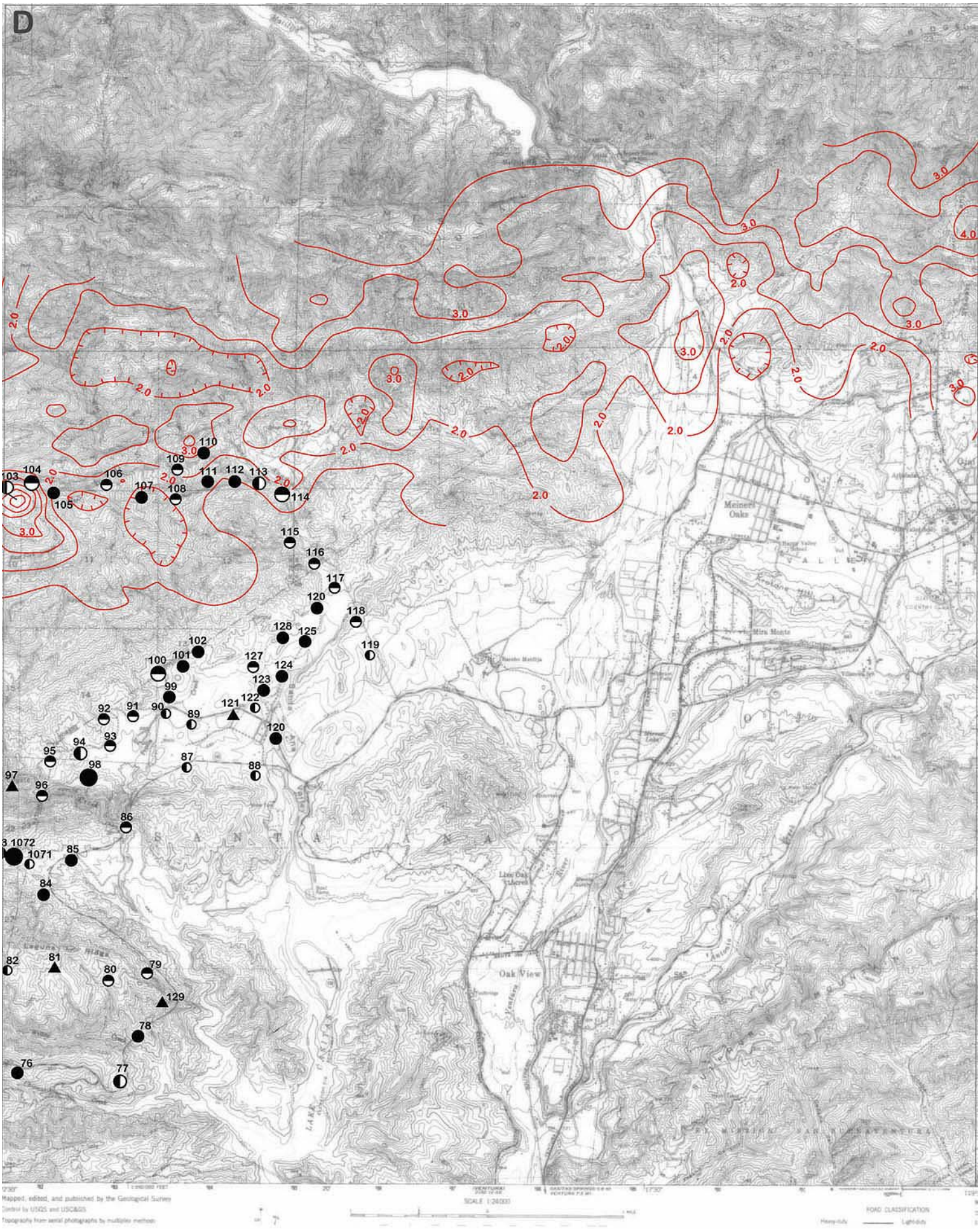
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Oak View
SANTA ANA
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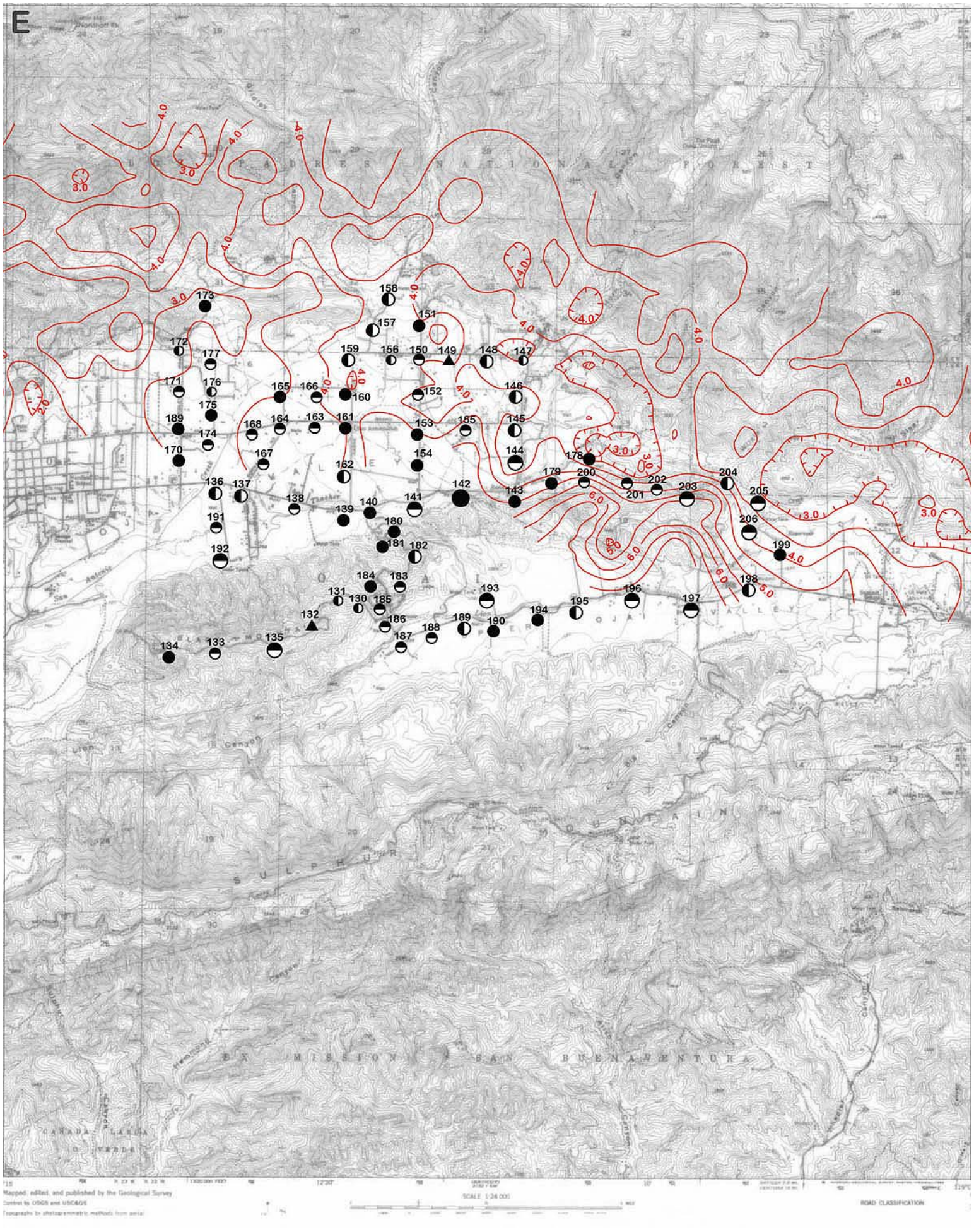
ROAD CLASSIFICATION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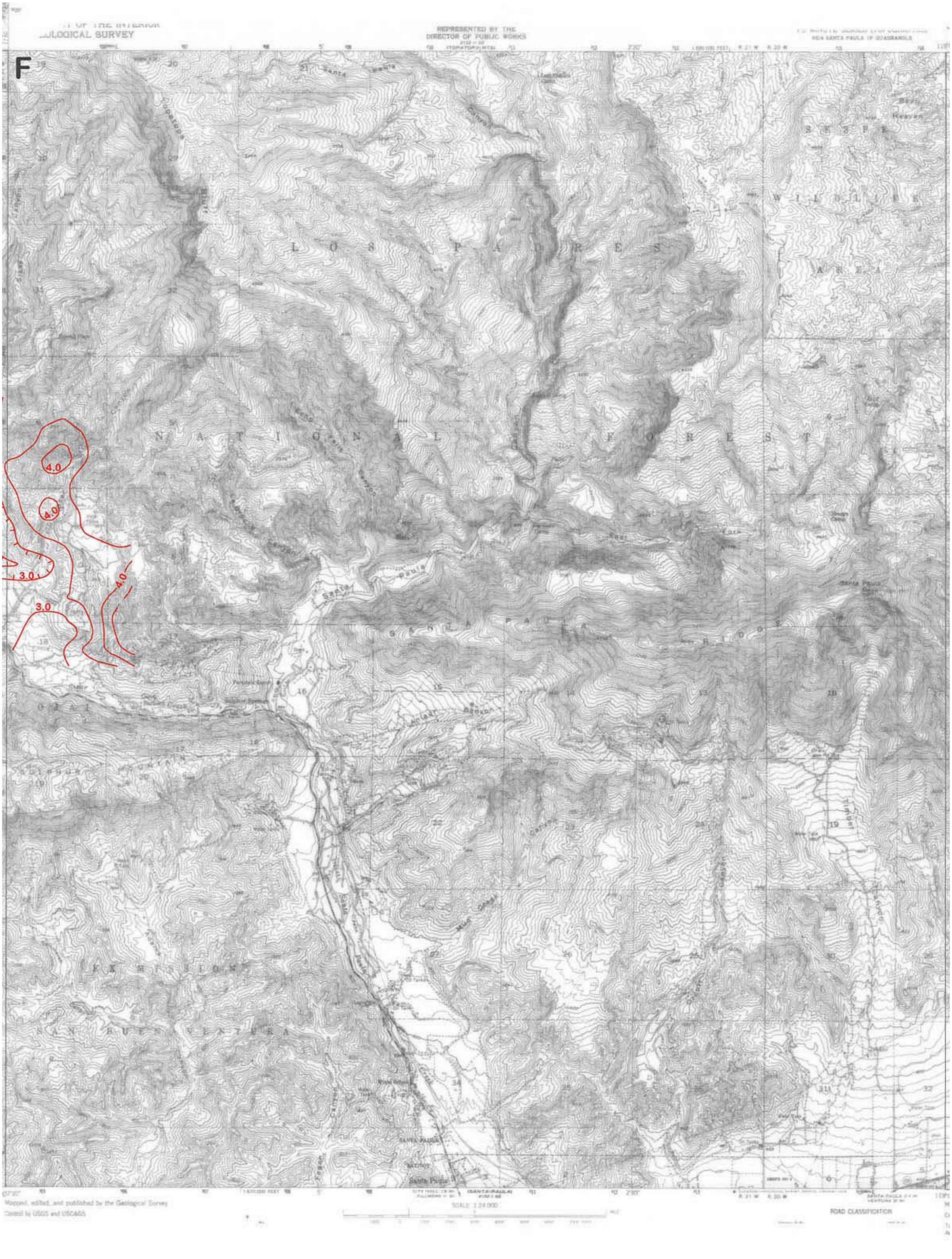

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Aliso Canyon
Sespe
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Control by USGS and USC&GS
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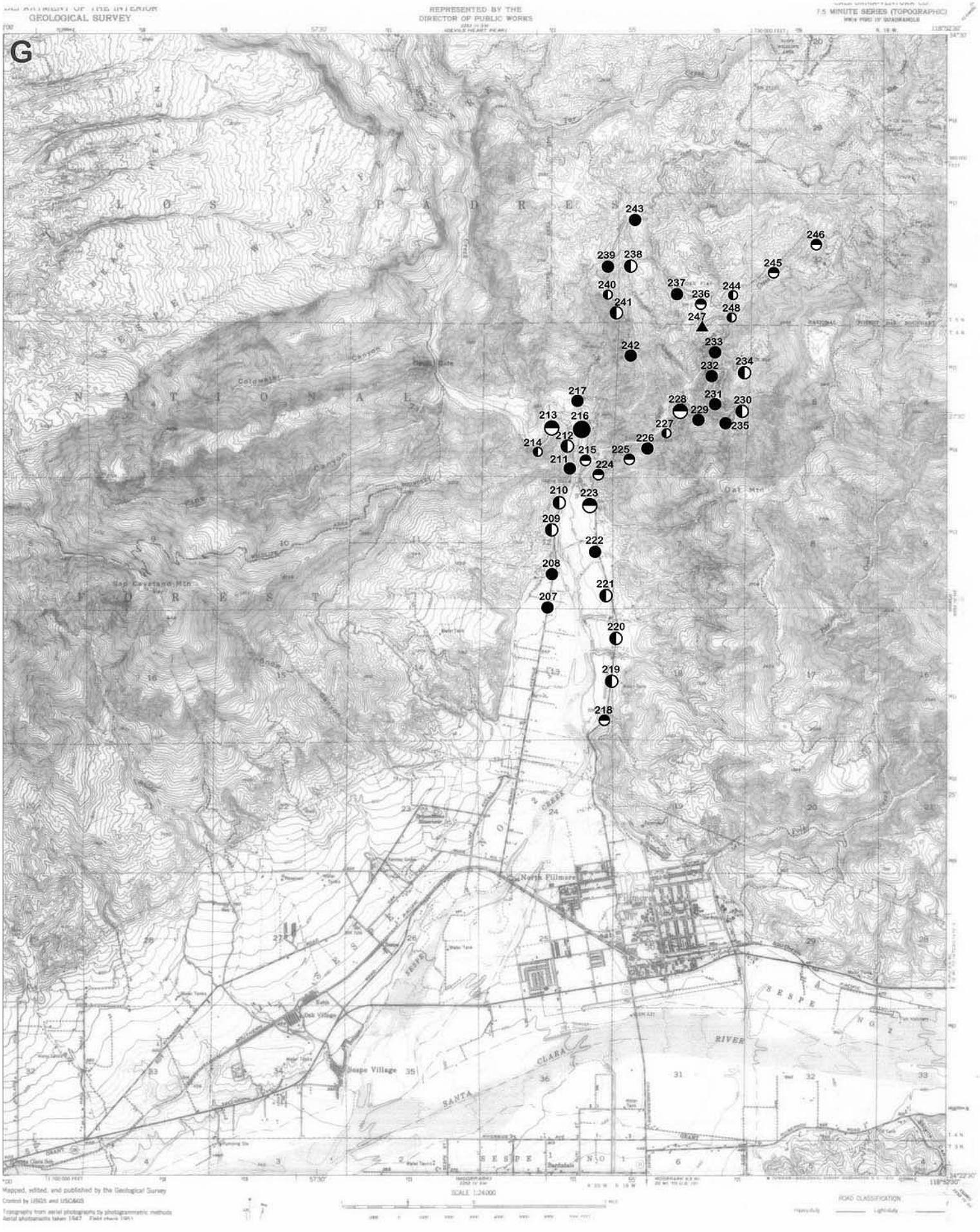
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